THE FOOD AND FEEDING RELATIONSHIPS OF THE FISH COMMUNITIES IN THE INSHORE WATERS OF KHOR AL-ZUBAIR, NORTH-WEST ARABIAN GULF

by

N.A. NASIR (1)

ABSTRACT. - The feeding relationships of the fish community in the inshore waters of Khor Al-Zubair (North-West Arabian Gulf) were investigated from June 1986 to June 1987. On the basis of stomach content analysis of the 16 commonest species, three major food types (bivalves, crabs and shrimps) were found. The degree of dietary overlap among the species studied was approximately 9.6%, and this is similar to those found for other marine fish communities. Diet similarity between each pair species was calculated. The results suggest that these fish may be in direct competition for food.

RÉSUMÉ. - Nourriture et relations alimentaires des communautés de poissons dans les eaux côtières de Khor Al-Zubair, nord-ouest du Golfe arabique.

Les relations alimentaires des communautés de poissons dans les eaux côtières de Khor Al-zubair, au nord-ouest du Golfe arabique, ont été étudiées de juin 1986 à juin 1987. Trois types principaux d'aliments (bivalves, crabes et crevettes) ont été définis à partir de l'analyse des contenus stomacaux des 16 espèces les plus communes. Le degré de recouvrement des régimes alimentaires des espèces étudiées est proche de 9,6%, et cette valeur est semblable à celle qui a été trouvée pour d'autres communautés ichtyologiques marines. Les similarités entre régimes alimentaires ont été calculées pour chaque paire d'espèces. Les résultats suggèrent que ces espèces peuvent être en compétition directe pour la nourriture.

Key words. - Fish community - ISW - Arabian Gulf - Food overlap - Diet - Competition.

Marine fish which live in deeper water and enter the shallower intertidal and subtidal zone, in particular during the growing season, play an important role as predators in coastal areas. Biological studies on some important fishes of the Arabian Gulf in Kuwait inshore waters have been done by several workers (Abdullah and Hussain, 1977; Abu-Hakima *et al.*, 1982; Al-Ghais, 1983; Samuel and Mathews, 1987; Abu-Seedo, 1992; Hashim, 1993), but there is a lack of information about the marine fishes of the Iraqi coast (Nasir and Ali, 1986). The present work was designed to gather information on the food composition and diet similarity for marine fish species living together at Khor Al-Zubair (Fig. 1), which is a north-western extension of the Arabian Gulf, situated on the south-west of Basrah province, Iraq (approximately 30°00'-30°20'N and 47°45'-48°00'W). It is an estuarine, lagoonal environment about 40 km long, representing an area of 60 km^2 covered by water during spring high tides. The average tidal range is 3.2 m. The bottom of this area is rocky, muddy and muddy sandy (Al-Hassan and Muhsin, 1986; Nasir and Ali, 1986; Al-Saad *et al.*, 1995). The muddy flats are similar to those of other parts of the northern region of the Arabian Gulf (Jones, 1986). Water temperature

(1) Hodeidah University, Faculty of Marine Science and Environment, P.O. Box 3114, REPUBLIC OF YEMEN.

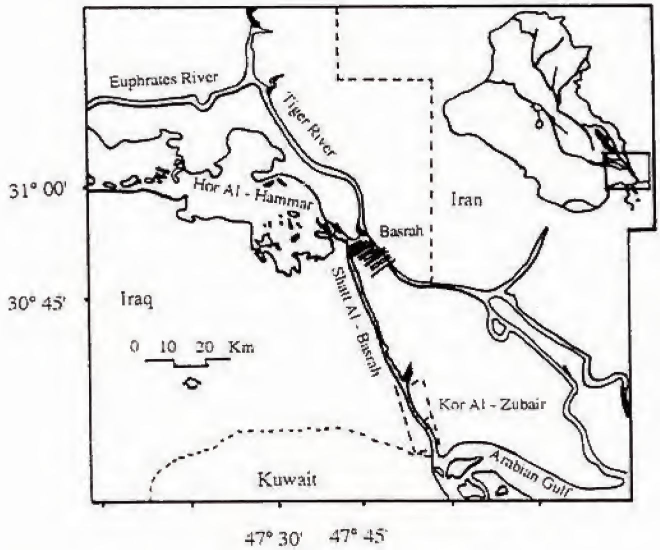

Fig. 1. - Location of the Khor Al-Zubair, North-West of the Arabian Gulf.

ranged from 12.0°C in December to 52.1°C in July. Salinity ranged from 9.1‰ in July during the high freshwater discharge period to 43.0‰ in November. The pH ranged from 7.1 in September to 8.3 in June (Nasir, 1987).

MATERIALS AND METHOD

Fish samples were collected by seine and 2-metre beam trawl from June 1986 to June 1987. All samplings were carried out in daylight. The 2 m beam trawl was towed by a 4.2 m dinghy, powered by a 25 H.P. outboard motor (Nasir, 1985). After the end of each haul the fishes were sorted, preserved on ice, and transported to the laboratory, where they were measured and weighed. Stomach contents were dissected and kept in 10% neutral formalin. The numbers of full and empty stomachs were recorded. The stomach fullness was assessed and a maximum of 8 points was awarded to a full stomach (Hynes, 1950; Poxton *et al.*, 1983; Nasir, 1985).

Composition of the diet

The food from each stomach was identified and divided into main taxonomic groups. Three measurements were used: (1) occurrence percentage (Hynes, 1950; Lande, 1973) - the percentage of stomachs in which a food type occurred; (2) a numerical percentage (Lande, 1973; Nasir, 1985) - the percentage of each food type in the total number of food items eaten in all stomachs; and (3) a gravimetric percentage (Poxton *et al.*, 1983; Nasir, 1985) - the percentage of each food in the total wet weight of food eaten.

Radforth (1940) reported that different methods might produce quite different results. Windell (1971) suggested that combined indices are more valuable than single indices. Several combinations have been used by many biologists (Dragovitch, 1970;

Tyler, 1972; Lande, 1973). For this work, the relative importance of index (RI_a) for food type has been used and calculated as:

$$RI_a = \frac{100 \times AI_a}{\sum_{a=1}^{n} AI_a} \qquad \text{(George and Hadley, 1979)}$$

where: AI_a = absolute importance index for a; calculated as AI_a = % frequency occurrence +% total number +% total weight for food type a; n = number of different food types.

Food overlap

Dietary similarity between species was estimated using the similarity coefficient ($C\lambda$) of Zaret and Rand (1971):

$$C\lambda = \frac{2\sum_{i=1}^{s} X_i Y_i}{\sum_{i=1}^{s} X_i^2 + \sum_{i=1}^{s} Y_i^2}$$

where: S = total number of food groups; X_i = total proportion of the total diet of the food group (i) (expressed as % of total wet weight) allotted in the diet of species X; Y_i = proportion (i) in the diet of species Y.

RESULTS

Catch statistics

Throughout the surveys, *Acanthopagrus latus*, *Euryglossa orientalis*, *Cynoglossus arel*, *Pseudorhombus arsius*, *Arius thalassinus*, *Solea elongata* and *Johnius dussumieri* were the dominant fish species. They accounted for 89% of the total catch, followed by *Rhynchobatus djiddensis*, *Cheimerius nufar*, *Thryssa mystax*, *Himantura uarnak*, *Eleutheronema tetradactylum*, *Otolithes ruber*, *Protonibea diacanthus*, *Leiognathus bindus* and *Platycephalus indicus*. These species made up to 8% of the total catch (Table I). The remaining 3% are formed by 35 species which are listed in table I.

Composition of the diet

The food groups eaten by the sixteen fish species were expressed in terms of percent of total number, occurrence and wet weight (Table II) and the RI_a values are shown in table III. The results indicated that majority of the fish examined are benthic feeders. It is clear from these tables that most fish species feed on three main food types, namely, bivalves, crabs and shrimps. Young fish also formed a relatively large part of the diet of *Pseudorhombus arsius* (RI_a = 55.6). Other minor food groups included isopods, amphipods, cumaceans, and aquatic plants.

Abra cadabra and *Tellina tenuis* were the most important bivalves occurring in the diet. *Placenta placenta* and *Anadara antiquata* were other bivalves that were also eaten and bivalve siphons (mostly siphon of *Tellina* sp.) were also found in the stomachs. Crustaceans consistently formed an important food of the fish. The most frequently eaten crabs

Table I. - Catch statistics of the fish sampled from Khor Al-Zubair.

Species	Family	Nos. caught	% of total
Acanthopagrus latus (Houttuyn, 1872)	Sparidae	870	36.50
Euryglossa orientalis (Bloch & Schneider, 1801)	Soleidae	403	16.80
Cynoglossus arel (Bloch & Schneider, 1801)	Cynoglossidae	200	8.38
Pseudorhombus arsius (Hamilton, 1822)	Paralichthyidae	192	8.10
Arius thalassinus (Rüppel, 1837)	Ariidae	190	8.00
Solea elongata (Day 1877)	Soleidae	140	5.90
Johnius dussumieri (Cuvier, 1830)	Sciaenidae	130	5.50
Rhynchobatus djiddensis (Forsskål, 1775)	Rhinobatidae	50	2.10
Cheimerius nufar (Valenciennes, 1830)	Sparidae	50	2.10
Thryssa mystax (Bloch & Schneider, 1801)	Engraulidae	20	0.80
Himantura uarnak (Forsskål, 1775)	Dasyatidae	20	0.80
Eleutheronema tetradactylum (Shaw, 1804)	Polynemidae	10	0.40
Otolithes ruber (Bloch & Schneider, 1801)	Sciaenidae	10	0.40
Protonibea diacanthus (Lacepède, 1802)	Sciaenidae	10	0.40
Leiognathus bindus (Valenciennes, 1835)	Leiognathidae	10	0.40
Platycephalus indicus (Linnaeus, 1758)	Platycephalidae	10	0.40
Acanthopagrus berda (Forsskål, 1775)	Sparidae	4	< 0.2
Acentrogobius viridipunctatus (Valenciennes, 1837)	Gobiidae	4	< 0.2
Aetomylaeus niehofii (Bloch & Schneider, 1801)	Myliobatidae	3	< 0.2
Boleophthalmus boddarti (Pallas, 1770)	Gobiidae	3	< 0.2
Carcharhinus leucas (Müller & Henle, 1839)	Carcharhinidae	3	< 0.2
Chiloscyllium griseum (Müller & Henle, 1838)	Hemiscyllidae	3	< 0.2
Chirocentrus dorab (Forsskål, 1775)	Chirocentridae	3	< 0.2
Epinephelus fuscoguttatus (Forsskål, 1775)	Serranidae	3	< 0.2
Epinephelus tauvina (Forsskål, 1775)	Serranidae	3	< 0.2
Hyporhamphus limbatus (Valenciennes, 1847)	Hemiramphidae	3	< 0.2
Himantura walga (Müller & Henle, 1841)	Dasyatidae	2	< 0.1
Ilisha melastoma (Schneider, 1801)	Clupeidae	2	< 0.1
Liza carinata (Valenciennes, 1836)	Mugilidae	2	< 0.1
Liza macrolepis (Smith, 1846)	Mugilidae	2	< 0.1
Liza subviridis (Valenciennes, 1836)	Mugilidae	2	< 0.1
Liza vaigiensis (Quoy & Gaimard, 1825)	Mugilidae	2	< 0.1
Nemipterus peronii (Valenciennes, 1830)	Nemipteridae	2	< 0.1
Nibea maculata (Bloch & Schneider, 1801)	Sciaenidae	2	< 0.1
Pampus argenteus (Euphrasen, 1788)	Stromateidae	2	< 0.1
Polydactylus sextarius (Bloch & Schneider 1801)	Polynemidae	2	< 0.1
Pomadasys argyreus (Valenciennes, 1833)	Haemulidae	2	< 0.1
Pristis pristis (Linnaeus, 1758)	Pristidae	2	< 0.1
Scatophagus argus (Linnaeus, 1766)	Scatophagidae	2	< 0.1
Selar crumenophthalmus (Bloch, 1793)	Carangidae	2	< 0.1
Siganus oramin (Bloch & Schneider, 1801)	Siganidae	1	< 0.1
Sillago sihama (Forsskål, 1775)	Sillaginidae	1	< 0.1

Species	Family	Nos. caught	% of total
Sparus hasta **(Valenciennes, 1830)**	Sparidae	1	< 0.1
Stolephorus commersonii **(Lacepède, 1803)**	Engraulidae	1	< 0.1
Strongylura strongylura **(Van Hasselt, 1823)**	Belonidae	1	< 0.1
Tenualosa ilisha **(Hamilton, 1822)**	Clupeidae	1	< 0.1
Thryssa hamiltonii **(Gray, 1835)**	Engraulidae	1	< 0.1
Eupleurogrammus muticus **(Gray, 1831)**	Trichiuridae	1	< 0.1
Trypauchen vagina **(Bloch & Schneider, 1801)**	Gobiidae	1	< 0.1
Strongylura leiura **(Bleeker, 1850)**	Belonidae	1	< 0.1
Total		**2386**	

were *Macrophthalmus depressus* and *Cleistostoma kuwaitiensis*, and the shrimp *Exopalaemon styliferus*. This may be related both to the activity and abundance of this species. *Cymodoce richardsoniae*, *Elasmopus pectinicrus* and *Heterocuma andamani* were the only isopod, amphipod and cumacean, respectively, found in the fish stomachs.

Food overlaps

The diet similarity for the principal food items between each two fish species is presented in table IV. According to Zaret and Rand (1971), and to Kislalioglu and Gibson (1977), values greater than 0.60 represent a significant overlap. Therefore, it appears that in most cases the overlap is significant between the 16 species studied. This indicates that most fish species in this area take similar proportions of the food available. *Acanthopagrus latus* clearly shows significant overlap only with *Euryglossa orientalis*, *Pseudorhombus arsius* and *Johnius dussumieri*. *Euryglossa orientalis* has a high degree of overlap with *Arius thalassinus* ($C\lambda = 0.89$) feeding on bivalves. High overlap occurs between *Cynoglossus arel* and *Arius thalassinus* ($C\lambda = 1.00$). Dietary similarities with respect to shrimp are greatest ($C\lambda = 1.00$) between some fish species of this community: *Rhynchobatus djiddensis*, *Thryssa mystax*, *Himantura uarnak*, *Eleutheronema tetradactylum*, *Otolithes ruber*, and *Platycephalus indicus*.

DISCUSSION

Two types of feeding behaviour were noticed during this study. Most of fish feed on epifauna and on free-swimming organisms on and off the bottom. The analyses and the comparison of the food were based on pooled samples collected during the period of the study. The pooling samples were used to give an overall picture of the feeding relationships and rather than analysis of temporal changes in the food during the sampling period. It was important to compromise between complete studies of seasonal changes in food and also to obtain samples of sufficient size (Gibson and Ezzi, 1980). Several species were excluded from this study because of their low numbers. Most of these fish fed mainly on algae and zooplankton but are not considered to be significant competitors with the other fish.

The percentages of empty stomachs and fullness values are also shown in table II. The differences in these calculations might be affected by several factors such as the quantity of food available (Keast and Welsh, 1968; Nasir, 1985), the season (Lande, 1973),

Table II. - Percentage of occurrence (% O), percentage of total wet weight (% W) and Percentage of total number (% N) of the common food items in the diets of the most important sixteen fish species from Khor Al-Zubair. S.E.: Stomach examined; E.S.: Empty stomach; F: Stomach fullness.

	Stomachs			Bivalves			Crabs			Shrimps			Amphipods			Cumaceans			Aquatic plants			Aquatic insects			Fish		
	S.E	E.S.	F	O	N	W	O	N	W	O	N	W	O	N	W	O	N	W	O	N	W	O	N	W	O	N	W
Species	No.	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
A. latus	870	58	19	16	37	6	14	5	46	5	1	17	8	50	7	-	-	-	22	6	21	22	1	3			
E. orientalis	400	38	32	8	13	4	84	73	97	-	-	-	-	-	-	-	-	-	-	-	-						
C. arel	200	0	63	100	100	100	-	-	-										-	-	-						
P. arsius	192	50	40	-	-	-	-	-	-	50	50	6	-	-	-	-	-	-	-	-	-	-	-	-	50	50	94
A. thalassinus	190	5	50	100	100	100	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
S. elongata	140	39	18	-	-	-	8	2	2	67	58	69	-	-	-	8	4	5							25	20	4
J. dussumieri	130	8	32	40	50	14	31	17	34	40	33	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R. djiddensis	50	0	55	-	-	-	-	-	-	100	100	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. nufar	50	20	35	-	-	-	50	40	75	50	50	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. mystax	20	50	6							100	100	100															
H. uarnak	20	0	54							100	100	100															
E. tetradactylum	10	0	38							100	100	100															
O. ruber	10	0	13							100	100	100															
P. diacanthus	10	0	13				100	100	100																		
L. bindus	10	0	75							100	100	100															
P. indicus	10	0	8							100	100	100															

Table III. - Relative Importance Indices (RII) of the common food items in the diets of sixteen different fish species from Khor Al-Zubair. *: Principal food items which occurred in 10.0% or more of the fish stomach examined; Total RII*: Total of principal food items taken by each fish species.

	Size group	Bivalves	Crabs	Shrimps	Amphipods	Cumaceans	Fish	Isopods	Aquatic plants	Aquatic insects	Total
Species	(mm)	%	%	%	%	%	%	%	%	%	RII
Acanthopagrus latus	89 – 243	20.0*	25.0*	9.3	23.2	-	-	-	20.7*	1.2	66.3
Euryglossa orientalis	144 – 223	6.5	93.5*	-	-	-	-	-	-	-	93.5
Cynoglossus arel	197 – 313	100.0*	-	-	-	-	-	-	-	-	100.0
Pseudorhombus arsius	96 – 280	-	-	44.4*	-	-	55.6*	-	-	-	100.0
Arius thalassinus	205 – 352	100.0*	-	-	-	-	-	-	-	-	100.0
Solea elongata	144 – 302	-	4.3	68.2*	-	4.4	18.4*	-	-	4.5	86.6
Johnius dussumieri	69 – 172	33.5*	25.9*	40.6*	-	-	-	-	-	-	100.0
Rhynchobatus djiddensis	276 – 289	-	-	100.0*	-	-	-	-	-	-	100.0
Cheimerius nufar	65 - 75	-	50.9*	34.0*	-	-	-	15.1*	-	-	100.0
Thryssa mystax	68 - 82	-	-	100.0	-	-	-	-	-	-	100.0
Himantura uarnak	81 - 120	-	-	100.0	-	-	-	-	-	-	100.0
Eleutheronema tetradactylum	65 - 92	-	-	100.0	-	-	-	-	-	-	100.0
Otolithes ruber	73 - 99	-	-	100.0	-	-	-	-	-	-	100.0
Protonibea diacanthus	68 - 88	-	100.0	-	-	-	-	-	-	-	100.0
Leiognathus bindus	67 - 81		-	100.0	-	-	-	-	-	-	100.0
Platycephalus indicus	66 - 77	-	-	100.0	-	-	-	-	-	-	100.0

Table IV. - Food similarity calculation comparing the proportion of principal food groups taken by different fish species from Khor Al-Zubair (values for the similarity coefficient, Cλ).

	E. orientalis	*C. arel*	*P. arsius*	*A. thalassinus*	*S. elongata*	*J. dussumieri*	*R. djeddensis*	*C. nufar*	*T. mystax*	*H. uarnak*	*E. tetradactylum*	*O. ruber*	*P. diacanthus*	*P. indicus*
A. latus	0.71	0.12	0.60	0.12	0.34	0.77	0.48	0.15	-	-	-	-	-	-
E. orientalis	-	0.07	-	0.89	0.09	0.62	-	-	-	-	-	-	-	-
C. arel	-	-	-	1.00	-	0.03	-	-	-	-	-	-	-	-
P. arsius	-	-		-	0.34	0.21	0.74	1.00	-	-	-	-	-	-
A. thalassinus	-	-	-	-	-	0.03	-	-	-	-	-	-	-	-
S. elongata	-	-	-	-	-	0.97	0.93	0.60	0.93	-	0.93	0.43	-	-
J. dussumieri	-	-	-	-	-	-	0.70	0.70	0.70	-	0.70	0.70	0.60	-
R. djiddensis	-	-	-	-	-	-	-	0.61	1.00	1.00	1.00	1.00	-	-
C. nufar	-	-	-	-	-	-	-	-	0.61	0.61	0.61	0.61	1.00	-
T. mystax	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	-	-
H. uarnak	-	-	-	-	-	-	-	-	-	-	1.00	1.00	-	-
E. tetradactylum	-	-	-	-	-	-	-	-	-	-	-	1.00	-	-
O. ruber	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00
P. diacanthus	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00
L. bindus	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00

light intensity (Jones, 1952; Blaxter, 1968), and the tidal condition (Kuipers, 1973; Thijssen *et al.*, 1974).

Food overlaps and competition for food

It is clear from table III that 9 food groups occurred in the fish stomachs examined. Many of these preys were more predominant in the diet than others and some were only eaten by a few of the fish. Six groups of food are considered as principal food items (Tyler, 1972; Kislalioglu and Gibson, 1977), that is as occurring in 10.0% or more of the fish stomachs examined, namely bivalves, crabs, shrimps, isopods, fish and aquatic plants. These food items made up 66.3% to 100% of the total RIa of food in each species (mean 90.9). The number of principal food groups taken by fish species ranged from 1 to 3 with a mean value of 2, indicating that most of the fish, except *Acanthopagrus latus*, *Solea* spp. and *Cheimerius nufar*, depended on relatively few food groups. This could reduce to some extent feeding competition between the fish species, which may reflect prey abundance (Pianka, 1976), but there is no evidence available from this study to determine whether food supply is scarce or present in large quantity. Dietary similarity calculations (Table IV) show that in 38 out of a total of 50 comparisons the index equals or exceeds 0.60. This indicates that more than half of the fish in this area takes similar proportions of the food available. It could also be suggested from these results that those fish species might be in direct competition for food. However, seasonal changes in the proportion of food eaten, depth characteristics, feeding behavior, fish size, prey size and food abundance may reduce the similarity of the food between fish species (Gibson, 1973; Kislalioglu and Gibson, 1977).

The degree of food overlap between fish species was calculated among all the fish investigated in this study following Tyler (1972) and Kislalioglu and Gibson (1977). The value (9.6%) obtained is comparable to the results of other studies (Table V). Tyler (1972) stated that the data from other assemblages of marine fish, when reworked as partition could be directly compared with each other. Although the validity of these comparisons is found to be affected by the degree of subdivision of the food groups, they do suggest that it is common for available resources to be shared between different species in the same community (Kislalioglu and Gibson, 1977). However, seasonal changes in the proportion of food taken may reduce further the similarity of the food between species (Nasir, 1985).

Table V. - Percentage of dietary overlap for marine fish species in nine different areas.

Area	% overlap	Author
Sakhaline coast	10	Skalhin, 1950 (recalculated by Tyler, 1972)
Manx waters (Irish sea)	15	Nagabhushanam, 1965 (recalculated by Tyler, 1972)
Banyuls region (Mediterranean)	31	Gibson, 1968
Atlantic coast of France	36	Gibson, 1972
Passamaguddy bay	16 – 24	Tyler, 1972
Loch etive (Western Scotland)	14.7	Kislalioglu and Gibson, 1977
Firth of Forth (Eastern Scotland)	28.9	Nasir, 1985
Qatar inshore water (Arabian Gulf)	27.5	Nasir, 1997
Khor Al-Zubair (Arabian Gulf)	9.6	Present study

Acknowledgements. - The author wishes to acknowledge with gratitude Mr. K.H. Nasir, the captain and his crew of the ship of Basrah University, for their help in sampling under difficult conditions.

REFERENCES

ABDULLAH M.A.S. & N.A. HUSSAIN, 1977. - The length-weight relationship, spawning season and food habits of six commercial fishes in Kuwait water. *Indian J. Fish.*, 24(12): 181-194.

ABOU-SEEDO F.S., 1992. - Abundance of fish caught by stake-trape (hadra) in the intertidal zone in Doha, Kuwait Bay. *J. Univ. Kuwait (Sc.)*, 19: 91-100.

ABU-HAKIMA R., AL-ABDUL-ELAH K.M., EL-ZAHR C., AKATSU S., AL-SHOUSHI M. & M.S. ABDULLAH, 1982. - Spawning season and fecundity of six commercially important food fishes found in Kuwait. Annual Research Report, pp. 74-76. Kuwait Institute for Scientific Research.

AL-HASSAN L.A.J. & K.A. MUHSIN, 1986. - The presence of *Barbus luteus* and *Heteropneustes fossilis* in the Khor Al-Zubair, North-West of the Arabian Gulf. *Zool. Middle East*, 1: 116-118.

AL-GHAIS S.M., 1983. - Some aspects of the biology of *Siganus canaliculatus* in the southern Arabian Gulf. *Bull. Mar. Sci.*, 52: 886-897.

AL-SAAD H., ABAYCHI J. & S. SHAMSHOOM, 1995. - Hydrocarbons in the waters and sediments of Shatt Al-Arab Estuary and North West of the Arabian Gulf. *Mar. Mesop.*, 10(2): 393-410.

BLAXTER J.H.S., 1968. - Light intensity, vision and feeding in young plaice. *J. Ecol. Exp. Mar. Biol.*, 2: 293-307.

DRAGOVITCH A., 1970. - The food of blue fin tuna (*Thunnus thunnus*) in the western North Atlantic Ocean. *Trans. Am. Fish. Soc.*, 99: 726-728.

GEORGE E.L. & W.F. HADLEY, 1979. - The food and habitat partitioning between rock bass (*Ambloplites rupestris*) and small mouth bass (*Micropterus dolomieui*) young of the year. *Trans. Am. Fish. Soc.*, 108: 253-261.

GIBSON R.N., 1973. - The intertidal movements and distribution of young fish on a sandy beach with special references to the plaice *Pleuronectes platessa* (L.). *J. Exp. Mar. Biol. Ecol.*, 12: 79-102.

GIBSON R.N. & E.A. EZZI, 1980. - The biology of the Scald fish *Arnoglossus laterna* (Walbaum) on the west coast of Scotland. *J. Fish Biol.*, 19: 697-714.

HASHIM O.A., 1993. - Fisheries study in the Gulf. *Mar. Pollut. Bull.*, 27: 275-284.

HYNES H.B.N., 1950. - The food of freshwater sticklebacks (*Gasterosteus aculeatus* and *Pygosteus pungitius*) with a review of methods used in the studies of the food fishes. *J. Anim. Ecol.*, 19: 36-58.

KEAST A. & L. WELSH, 1968. - Daily feeding periodicities food uptake rates and dietary changes with hour of day in some lake fishes. *J. Fish. Res. Bd. Can.*, 25: 1133-1144.

JONES D.A., 1986. - A Field Guide to the Sea Shores of Kuwait and the Arabian Gulf. 192 p. Kuwait Univ.

JONES N.S., 1952. - The bottom fauna and the food of flatfish off Cumberland coast. *J. Anim. Ecol.*, 21: 182-205.

KISLALIOGLU M. & R.N. GIBSON, 1977. - The feeding relationship of shallow water fishes in a Scottish Sea Loch. *J. Fish Biol.*, 11: 257-266.

KUIPER B.R., 1973. - On the ecology of juvenile plaice on a tidal flat in the Wedden Sea. *Neth. J. Sea Res.*, 11: 56-91.

LANDE R., 1973. - Food and feeding habits of plaice *Pleuronectes platessa* L. in Brogenfjorden North - Trondelag, Norweg. *J. Zool., Lond.*, 21: 91-100.

NASIR N.A., 1985. - Ecology of the plaice (*Pleuronectes platessa* L.) in Broad Sands Bay, Firth of Forth. Ph.D. Thesis, 328 p. Heriot-Watt Univ.

NASIR N.A., 1987. - Ecological surveys on the fauna of Khor Al-Zubair, north west of the Arabian Gulf. *In:* Proc. Int. Symp. Living Resources of the Arabian Sea, paper n°9. Karachi (Pakistan): National Institute of Oceanography.

NASIR N.A., 1997. - The food and feeding relationships of the fish community in the inshore water of Qatar. *In:* Proc. Int. Conf. on the Biology of coastal Environments, paper n°14. Bahrain: Bahrain Univ.

NASIR N.A. & M. ALI, 1986. - An ecological survey in Khor Al-Zubair, north west of the Arabian Gulf. *In:* Final Report. The 18-Month Pollution Monitoring and Research Programme in Iraq. Biology section. Kuwait: ROPME, & Iraq: Basrah Univ.

PIANKA E.R., 1976. - Competition and niche theory. *In:* Theoretical Ecology. Principles and Applications (May R.M., ed.), pp. 114-141. Philadelphia: W.B. Saunders.

POXTON M.G., ELEFTHERIOU A. & A.D. MCLNTYRE, 1983. - The food and growth of 0-group flatfish on nursery grounds in the Clyde Sea Area. *Estuar, Coast. Shelf Sci.*, 17: 317-337.

RADFORTH I., 1940. - The food of graying (*Thymallus thymallus*), flounder (*Platichthys flesus*), roach (*Rutilus rutilus*) and gudgeon (*Gobio fluviatilis*), with special reference to the Tweed watershed. *J. Anim. Ecol.*, 9: 302-313.

SAMUEL M. & C.P. MATHEWS, 1987. - Growth and mortality of four *Acanthopagrus* species. *Kuwait Bull. Mar. Sci.*, 9: 159-171.

THIJSSEN R., LEVER A.J. & J. LEVER, 1974. - Food composition and feeding periodity of 0-group plaice (*Pleuronectes platessa*) in the tidal area of a sandy beach. *Neth. J. Sea. Res.*, 8: 369-377.

TYLER A.V., 1972. - Food resources division among northern marine demersal fishes. *J. Fish. Res. Bd. Can.*, 29: 997-1003.

WINDEL J.T., 1971. - Food analysis and rate of digestion. *In:* Methods for Assessment of Fish Production in Freshwater (Ricker W.E., ed.), 2nd ed. 226 p. Oxford: Blackwell Scientific Publication.

ZARET T.M. & A.S. RAND, 1971. - Competition in tropical stream fishes. Support for the competitive exclusion principle. *Ecology*, 52: 336-342.

Reçu le 06.12.1996.
Accepté pour publication le 24.11.1999.